

Using Cassini UVIS Data to Constrain Enceladus' Libration State

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Given the non-spherical shape of Enceladus, the satellite may experience gravitational torques that will cause it to physically librate as it orbits Saturn. Physical libration would produce a diurnal oscillation in the longitude of Enceladus' tidal bulge, which could have a profound effect on the diurnal stresses experienced by the surface of the satellite. Although Cassini ISS has placed an observational upper limit on Enceladus' libration amplitude, small amplitude librations may have geologically significant consequences. For example, a physical libration will affect heat production along the tiger stripes as produced by tidal shear heating and a previous study has explored possible libration states that provided better matches to Cassini CIRS observations of heat along the tiger stripes.

Cassini UVIS stellar occultations provided measurements of the column density of the Enceladus plume at two different points in Enceladus' orbit and find comparable column density values. This column density may be a reflection of the amount of the tiger stripe rifts in tension and able to vent volatiles and a physical libration will also affect the fraction of tiger stripe in tension at different points in the orbit. We have modeled the expected fraction of tiger stripes in tension under different libration conditions. Without libration the amount of tiger stripe rifts in tension at both points in the orbit would not be comparable and therefore may not allow comparable amounts of volatiles to escape. However, we identify libration conditions that do allow comparable amounts of the tiger stripes to be in tension at each point in the orbit, which might lead to comparable column densities. The librations identified coincide with possible librations states identified in the earlier study, which used Cassini CIRS observations.